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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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J. Rodney Walton

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EXAMINER

ALIA, CURTIS A

ART UNIT

PAPER NUMBER

2474

NOTIFICATION DATE

DELIVERY MODE

04/01/2011

ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No. 10/781,951	Applicant(s) WALTON ET AL.	
	Examiner Curtis A. Alia	Art Unit 2474	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 January 2011.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-23 and 63 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-23 and 63 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

Applicant's amendment filed 18 January 2011 has been entered. Claims 1-23 and 63 are still pending in this application, with claims 1, 14, 19 and 63 being independent.

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Response to Arguments

1. Applicant's arguments with respect to claims 1-23 and 63 have been considered but are moot in view of the new ground(s) of rejection.

Regarding the Applicant's response to the rejection of the means plus function limitations, the Examiner acknowledges the Applicant's intention to invoke 112, 6th paragraph means plus function. Examiner respectfully submits that there is insufficient disclosure to support means plus function limitations presently in the claim. Under the Section 112, 2nd paragraph section below is an explanation of the rejection based on insufficient disclosure.

Double Patenting

2. Claims 1-23 and 63 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-8, 10-24 and 65 of copending Application No. 10/794,918. Although the conflicting claims are not identical, they are not patentably distinct from each other because "data packet" and "protocol data unit (PDU)" are

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well known in the art to be equivalent data structures and are interchangeable. Protocol data units and packets are directly equivalent and do not render the claims of each application patentably distinct from one another. This is because a protocol data unit is a packet, and vice versa, because they are both broadly defined as sequences of data formatted to conform to a specific protocol.

In view of the above, it is noted that allowing claims 1-23 and 63 of the instant application would result in an unjustified or improper timewise extension of the “right to exclude” granted by a patent.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Instant Claims	Conflicting Claims
1. A method of transmitting data from a transmitting entity to a receiving entity in a wireless multi-antenna communication system utilizing orthogonal frequency division multiplexing (OFDM), comprising: processing a data packet to obtain a block of data symbols; demultiplexing pilot symbols and the block of data symbols onto a plurality of subbands to obtain, for the data packet, a plurality of sequences of pilot and data symbols for the plurality of subbands; and performing spatial processing on at least one of the pilot and data symbols for each subband with at least one steering vector selected for the subband, the spatial processing randomizing a plurality of effective single-input single-output (SISO) channels observed across the plurality of subbands.	1. A method of transmitting data from a transmitting entity to a receiving entity in a wireless multi-antenna communication system utilizing orthogonal frequency division multiplexing (OFDM), comprising: processing a protocol data unit (PDU) to obtain a block of data symbols; demultiplexing pilot symbols and the block of data symbols onto a plurality of subbands to obtain, for the PDU, a plurality of sequences of pilot and data symbols for the plurality of subbands; and performing spatial processing on at least one of the pilot and data symbols for each subband with at least one steering vector selected for the subband, the spatial processing randomizing a plurality of effective single-input single-output (SISO) channels observed across the plurality of subbands.
2. The method of claim 1, wherein the pilot and data symbols for each subband is spatially processed with one steering vector selected for the subband.	2. The method of claim 1, wherein the pilot and data symbols for each subband is spatially processed with one steering vector selected for the subband.
3. The method of claim 2, wherein a plurality of different steering vectors is used for the plurality of subbands.	3. The method of claim 2, wherein a plurality of different steering vectors is used for the plurality of subbands.
4. The method of claim 2, wherein the one steering vector used for the spatial processing of each	4. The method of claim 2, wherein the one steering vector used for the spatial processing of each

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subband is unknown to the receiving entity.	subband is unknown to the receiving entity.
5. The method of claim 1, wherein the pilot and data symbols for each subband is spatially processed with at least two steering vectors selected for the subband.	5. The method of claim 1, wherein the pilot and data symbols for each subband is spatially processed with at least two steering vectors selected for the subband.
6. The method of claim 1, wherein one pilot or data symbol is sent on each subband in each symbol period, and wherein the pilot and data symbols for each subband is spatially processed with a different steering vector for each symbol period.	6. The method of claim 1, wherein one pilot or data symbol is sent on each subband in each symbol period, and wherein the pilot and data symbols for each subband is spatially processed with a different steering vector for each symbol period.
7. The method of claim 1, wherein the at least one steering vector used for spatial processing for each subband is known only to the transmitting entity and the receiving entity.	7. The method of claim 1, wherein the at least one steering vector used for spatial processing for each subband is known only to the transmitting entity and the receiving entity.
8. The method of claim 1, wherein the spatial processing with the at least one steering vector for each subband is performed only on data symbols.	8. The method of claim 1, wherein the spatial processing with the at least one steering vector for each subband is performed only on data symbols.
9. The method of claim 1, wherein the processing a data packet includes encoding the data packet in accordance with a coding scheme to obtain coded data, interleaving the coded data to obtain interleaved data, and symbol mapping the interleaved data in accordance with a modulation scheme to obtain the block of data symbols.	10. The method of claim 1, wherein the PDU processing includes encoding the PDU in accordance with a coding scheme to obtain coded data, interleaving the coded data to obtain interleaved data, and symbol mapping the interleaved data in accordance with a modulation scheme to obtain the block of data symbols.
10. The method of claim 1, further comprising: selecting the at least one steering vector for each subband from among a set of L steering vectors, where L is an integer greater than one.	11. The method of claim 1, further comprising: selecting the at least one steering vector for each subband from among a set of L steering vectors, where L is an integer greater than one.
11. The method of claim 10, wherein the L steering vectors are such that any pair of steering vectors among the L steering vectors have low correlation.	12. The method of claim 11, wherein the L steering vectors are such that any pair of steering vectors among the L steering vectors have low correlation.
12. The method of claim 6, further comprising: selecting a steering vector for each subband in each symbol period from among a set of L steering vectors, where L is an integer greater than one.	13. The method of claim 6, further comprising: selecting a steering vector for each subband in each symbol period from among a set of L steering vectors, where L is an integer greater than one.
13. The method of claim 1, wherein each steering vector includes T elements having same magnitude but different phases, where T is the number of transmit antennas at the transmitting entity and is an integer greater than one.	14. The method of claim 1, wherein each steering vector includes T elements having same magnitude but different phases, where T is the number of transmit antennas at the transmitting entity and is an integer greater than one.
14. An apparatus in a wireless multi-antenna communication system utilizing orthogonal frequency division multiplexing (OFDM), comprising: a data processor operative to process a data packet to obtain a block of data symbols; a demultiplexer operative to demultiplex pilot symbols and the block of data symbols onto a plurality of subbands to obtain, for the data packet, a plurality of sequences of pilot and data symbols for the plurality of subbands; and	15. An apparatus in a wireless multi-antenna communication system utilizing orthogonal frequency division multiplexing (OFDM), comprising: a data processor operative to process a protocol data unit (PDU) to obtain a block of data symbols; a demultiplexer operative to demultiplex pilot symbols and the block of data symbols onto a plurality of subbands to obtain, for the PDU, a plurality of sequences of pilot and data symbols for the plurality of subbands; and

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a spatial processor operative to perform spatial processing on at least one of the pilot and data symbols for each subband with at least one steering vector selected for the subband, the spatial processing randomizing a plurality of effective single-input single-output (SISO) channels observed across the plurality of subbands.	a spatial processor operative to perform spatial processing on at least one of the pilot and data symbols for each subband with at least one steering vector selected for the subband, the spatial processing randomizing a plurality of effective single-input single-output (SISO) channels observed across the plurality of subbands.
15. The apparatus of claim 14, wherein the spatial processor is operative to spatially process the pilot and data symbols for each subband with one steering vector selected for the subband.	16. The apparatus of claim 15, wherein the spatial processor is operative to spatially process the pilot and data symbols for each subband with one steering vector selected for the subband.
16. The apparatus of claim 14, wherein the spatial processor is operative to spatially process the pilot and data symbols for each subband with at least two steering vectors selected for the subband.	17. The apparatus of claim 15, wherein the spatial processor is operative to spatially process the pilot and data symbols for each subband with at least two steering vectors selected for the subband.
17. The apparatus of claim 16, wherein the at least two steering vectors for each subband are known only to a transmitting entity and a receiving entity for the data packet.	18. The apparatus of claim 17, wherein the at least two steering vectors for each subband are known only to a transmitting entity and a receiving entity for the PDU.
18. The apparatus of claim 14, wherein each steering vector includes T elements having same magnitude but different phases, where T is the number of antennas used to transmit the data packet and is an integer greater than one.	19. The apparatus of claim 15, wherein each steering vector includes T elements having same magnitude but different phases, where T is the number of antennas used to transmit the PDU and is an integer greater than one.
19. An apparatus in a wireless multi-antenna communication system utilizing orthogonal frequency division multiplexing (OFDM), comprising: means for processing a data packet to obtain a block of data symbols; means for demultiplexing pilot symbols and the block of data symbols onto a plurality of subbands to obtain, for the data packet, a plurality of sequences of pilot and data symbols for the plurality of subbands; and means for performing spatial processing on at least one of the pilot and data symbols for each subband with at least one steering vector selected for the subband, the spatial processing randomizing a plurality of effective single-input single-output (SISO) channels observed across the plurality of subbands.	20. An apparatus in a wireless multi-antenna communication system utilizing orthogonal frequency division multiplexing (OFDM), comprising: means for processing a protocol data unit (PDU) to obtain a block of data symbols; means for demultiplexing pilot symbols and the block of data symbols onto a plurality of subbands to obtain, for the PDU, a plurality of sequences of pilot and data symbols for the plurality of subbands; and means for performing spatial processing on at least one of the pilot and data symbols for each subband with at least one steering vector selected for the subband, the spatial processing randomizing a plurality of effective single-input single-output (SISO) channels observed across the plurality of subbands.
20. The apparatus of claim 19, wherein the pilot and data symbols for each subband is spatially processed with one steering vector selected for the subband.	21. The apparatus of claim 20, wherein the pilot and data symbols for each subband is spatially processed with one steering vector selected for the subband.
21. The apparatus of claim 19, wherein the pilot and data symbols for each subband is spatially processed with at least two steering vectors selected for the subband.	22. The apparatus of claim 20, wherein the pilot and data symbols for each subband is spatially processed with at least two steering vectors selected for the subband.
22. The apparatus of claim 21, wherein the at least two steering vectors for each subband are known only to a transmitting entity and a receiving entity for the data packet.	23. The apparatus of claim 22, wherein the at least two steering vectors for each subband are known only to a transmitting entity and a receiving entity for the PDU.

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23. The apparatus of claim 19, wherein each steering vector includes T elements having same magnitude but different phases, where T is the number of antennas used to transmit the data packet and is an integer greater than one.	24. The apparatus of claim 20, wherein each steering vector includes T elements having same magnitude but different phases, where T is the number of antennas used to transmit the PDU and is an integer greater than one.
63. A memory unit for processing data for transmission from transmitting data from a transmitting entity to a receiving entity in a wireless multi-antenna communication system utilizing orthogonal frequency division multiplexing (OFDM) comprising a memory, the memory having instructions stored thereon, the instructions being executable by one or more processors and the instructions comprising: instructions for processing a data packet to obtain a block of data symbols; instructions for demultiplexing pilot symbols and the block of data symbols onto a plurality of subbands to obtain, for the data packet, a plurality of sequences of pilot and data symbols for the plurality of subbands; and instructions for performing spatial processing on at least one of the pilot and data symbols for each subband with at least one steering vector selected for the subband, the spatial processing randomizing a plurality of effective single-input single-output (SISO) channels observed across the plurality of subbands.	65. A memory unit for processing data for transmission from transmitting data from a transmitting entity to a receiving entity in a wireless multi-antenna communication system utilizing orthogonal frequency division multiplexing (OFDM) comprising a memory, the memory having instructions stored thereon, the instructions being executable by one or more processors and the instructions comprising: instructions for processing a protocol data unit (PDU) to obtain a block of data symbols; instructions for demultiplexing pilot symbols and the block of data symbols onto a plurality of subbands to obtain, for the PDU, a plurality of sequences of pilot and data symbols for the plurality of subbands; and instructions for performing spatial processing on at least one of the pilot and data symbols for each subband with at least one steering vector selected for the subband, the spatial processing randomizing a plurality of effective single-input single-output (SISO) channels observed across the plurality of subbands.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 19 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In the response filed 18 January 2011, it is stated that "applicant believes that Claim 19 is a means plus function claim..." The Examiner believes that this is an assertion that Applicant intends to invoke means plus function language under 35 U.S.C. 112, 6th paragraph.

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Since Applicant intended to invoke 35 U.S.C. 112, sixth paragraph, it is unclear to one of ordinary skill in the art whether the recited structure, material, or acts in the claim are sufficient for performing the claimed function. Since the claims are directed to computer-implemented means plus function subject matter, merely referencing to a general purpose computer with appropriate programming without providing any detailed explanation of the appropriate programming, the written description of the specification discloses no corresponding algorithm or simply reciting software without providing some detail about the means to accomplish the function, would not be an adequate disclosure of the corresponding structure to satisfy the requirement of 35 U.S.C. 112, second paragraph, even when one of ordinary skill in the art is capable of writing the software to convert a general purpose computer to a special purpose computer to perform the claimed function.

In this case, Figure 4 of the original specification shows a flow chart with each step corresponding to a means in claim 19. Also, Figures 8 and 9B of the original specification show the use of a computer that performs the all the "means for" limitations with the use of processors (such as spatial processor 730) and paragraph 121 of the specification briefly describes the use of "software/algorithm/modules" or process for the signal, there are few details of the algorithm or process for all the means for limitations. Thus, the Examiner cannot determine the metes and bounds of the claim due to these defects; the claim is indefinite.

Claim Rejections - 35 USC § 103

5. Claims 1-3, 14-15, 19-20 and 63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Trikkonen (previously cited US 2004/0002364) in view of Wallace et al. (previously cited US 6,473,467).

Regarding claim 1, Trikkonen discloses a method of transmitting data from a transmitting entity to a receiving entity in a wireless multi-antenna communication system utilizing orthogonal frequency division multiplexing (OFDM), comprising processing a PDU to obtain a block of data symbols (see paragraph 77, receiving data, processing data streams for transmission), demultiplexing pilot symbols and the block of data symbols onto a plurality of subbands to obtain, for the PDU, a plurality of sequences of pilot and data symbols for the plurality of subbands (see paragraphs 59-61, pilot signals are prepared for transmission, separated from the data stream, and multiple antennas are ready to transmit the data along separate bands) and performing spatial processing on at least one of the pilot and data symbols with at least one steering vector selected for the subband, the spatial processing randomizing a plurality of effective single-input single-output (SISO) channels observed across the plurality of subbands (see paragraphs 141-155, the channels are randomized, beamforming is used to steer the radio signal from the antennas (spatial processing), and sent across multiple antennas (plurality of effective SISO = MIMO)).

Trikkonen does not explicitly teach that the spatial processing is performed for each subband.

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However, the above-mentioned claimed limitation is well known in the art, as evidenced by Wallace. In particular, Wallace teaches that the spatial processing is performed for each subband (see column 21, lines 65+, each sub-channel (subband) data stream is provided to a spatial division processor for further demultiplexing, so spatial processing is performed for each subband to achieve one data sub-stream).

In view of the above, having the method of Trikkonen, then given the well-established teaching of Wallace, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen as taught by Wallace, since Wallace stated that a more rapid determination of the channel quality characteristics can be made.

Regarding claim 2, Trikkonen does not explicitly teach that the pilot and data symbols for each subband is spatially processed with one steering vector selected for the subband.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Wallace. In particular, Wallace teaches that the pilot and data symbols for each subband is spatially processed with one steering vector selected for the subband (see column 16, lines 50+ and 20, lines 34-43, pilot and data symbols are transmitted on the network, transmit symbols are spatially processed).

In view of the above, having the method of Trikkonen, then given the well-established teaching of Wallace, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen as taught by Wallace, since Wallace stated that a more rapid determination of the channel quality characteristics can be made.

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Regarding claim 3, Trikkonen does not explicitly teach that a plurality of different steering vectors is used for the plurality of subbands.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Wallace. In particular, Wallace teaches that a plurality of different steering vectors are used for the plurality of subbands (see column 21, lines 65+, spatial division processor provides modulation symbols in a vector for plurality of sub-channels (subbands), each vector corresponding to each subband).

In view of the above, having the method of Trikkonen, then given the well-established teaching of Wallace, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen as taught by Wallace, since Wallace stated that a more rapid determination of the channel quality characteristics can be made.

Regarding claim 14, Trikkonen discloses an apparatus in a wireless multi-antenna communication system utilizing orthogonal frequency division multiplexing (OFDM), comprising a data processor operative to process a PDU to obtain a block of data symbols (see paragraph 77, receiving data, processing data streams for transmission), a demultiplexer operative to demultiplex pilot symbols and the block of data symbols onto a plurality of subbands to obtain, for the PDU, a plurality of sequences of pilot and data symbols for the plurality of subbands (see paragraphs 59-61, pilot signals are prepared for transmission, separated from the data stream, and multiple antennas are ready to transmit the data along separate bands) and a spatial processor operative to perform spatial processing on at least one of the pilot and data symbols with at least one steering vector selected for the subband, the spatial

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processing randomizing a plurality of effective single-input single-output (SISO) channels observed across the plurality of subbands (see paragraphs 141-155, the channels are randomized, beamforming is used to steer the radio signal from the antennas (spatial processing), and sent across multiple antennas (plurality of effective SISO = MIMO)).

Trikkonen does not explicitly teach that the spatial processing is performed for each subband.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Wallace. In particular, Wallace teaches that the spatial processing is performed for each subband (see column 21, lines 65+, each sub-channel (subband) data stream is provided to a spatial division processor for further demultiplexing, so spatial processing is performed for each subband to achieve one data sub-stream).

In view of the above, having the method of Trikkonen, then given the well-established teaching of Wallace, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen as taught by Wallace, since Wallace stated that a more rapid determination of the channel quality characteristics can be made.

Regarding claim 15, Trikkonen does not explicitly teach that the spatial processor is operative to spatially process the pilot and data symbols for each subband with one steering vector selected for the subband.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Wallace. In particular, Wallace teaches that the spatial processor is operative to spatially process the pilot and data symbols for each subband with one steering vector selected for the

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subband (see column 16, lines 50+ and 20, lines 34-43, pilot and data symbols are transmitted on the network, transmit symbols are spatially processed).

In view of the above, having the method of Trikkonen, then given the well-established teaching of Wallace, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen as taught by Wallace, since Wallace stated that a more rapid determination of the channel quality characteristics can be made.

Regarding claim 19, Trikkonen discloses an apparatus in a wireless multi-antenna communication system utilizing orthogonal frequency division multiplexing (OFDM), comprising means for processing a PDU to obtain a block of data symbols (see paragraph 77, receiving data, processing data streams for transmission), means for demultiplexing pilot symbols and the block of data symbols onto a plurality of subbands to obtain, for the PDU, a plurality of sequences of pilot and data symbols for the plurality of subbands (see paragraphs 59-61, pilot signals are prepared for transmission, separated from the data stream, and multiple antennas are ready to transmit the data along separate bands), and means for performing spatial processing on at least one of the pilot and data symbols with at least one steering vector selected for the subband, the spatial processing randomizing a plurality of effective single-input single-output (SISO) channels observed across the plurality of subbands (see paragraphs 141-155, the channels are randomized, beamforming is used to steer the radio signal from the antennas (spatial processing), and sent across multiple antennas (plurality of effective SISO = MIMO)).

Trikkonen does not explicitly teach that the spatial processing is performed for each subband.

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However, the above-mentioned claimed limitation is well known in the art, as evidenced by Wallace. In particular, Wallace teaches that the spatial processing is performed for each subband (see column 21, lines 65+, each sub-channel (subband) data stream is provided to a spatial division processor for further demultiplexing, so spatial processing is performed for each subband to achieve one data sub-stream).

In view of the above, having the method of Trikkonen, then given the well-established teaching of Wallace, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen as taught by Wallace, since Wallace stated that a more rapid determination of the channel quality characteristics can be made.

Regarding claim 20, Trikkonen does not explicitly teach that the pilot and data symbols for each subband is spatially processed with one steering vector selected for the subband.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Wallace. In particular, Wallace teaches that the pilot and data symbols for each subband is spatially processed with one steering vector selected for the subband (see column 16, lines 50+ and 20, lines 34-43, pilot and data symbols are transmitted on the network, transmit symbols are spatially processed).

In view of the above, having the method of Trikkonen, then given the well-established teaching of Wallace, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen as taught by Wallace, since Wallace stated that a more rapid determination of the channel quality characteristics can be made.

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Regarding claim 63, Trikkonen discloses a software storage apparatus for processing data for transmission from a transmitting entity to a receiving entity in a wireless multi-antenna communication system utilizing orthogonal frequency division multiplexing (OFDM) comprising a memory, the memory having instructions stored thereon, the instructions being executable by one or more processors (see paragraph 44, processors are present in the device which would be able to execute instructions) and the instructions comprising instructions for processing a PDU to obtain a block of data symbols (see paragraph 77, receiving data, processing data streams for transmission), instructions for demultiplexing pilot symbols and the block of data symbols onto a plurality of subbands to obtain, for the PDU, a plurality of sequences of pilot and data symbols for the plurality of subbands (see paragraphs 59-61, pilot signals are prepared for transmission, separated from the data stream, and multiple antennas are ready to transmit the data along separate bands), and instructions for performing spatial processing on at least one of the pilot and data symbols with at least one steering vector selected for the subband, the spatial processing randomizing a plurality of effective single-input single-output (SISO) channels observed across the plurality of subbands (see paragraphs 141-155, the channels are randomized, beamforming is used to steer the radio signal from the antennas (spatial processing), and sent across multiple antennas (plurality of effective SISO = MIMO)).

Trikkonen does not explicitly teach that the spatial processing is performed for each subband.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Wallace. In particular, Wallace teaches that the spatial processing is performed for each subband (see column 21, lines 65+, each sub-channel (subband) data stream is provided to a

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spatial division processor for further demultiplexing, so spatial processing is performed for each subband to achieve one data sub-stream).

In view of the above, having the method of Trikkonen, then given the well-established teaching of Wallace, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen as taught by Wallace, since Wallace stated that reducing the computational resources required for maintaining a spatially distinct beam-forming transmissions is possible.

6. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Trikkonen in view of Wallace as applied to claim 2 above, and further in view of Honig (previously cited US 6,956,897).

Regarding claim 4, Trikkonen and Wallace do not explicitly teach that the one steering vector used for spatial processing for each subband is unknown to the receiving entity.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Honig. In particular, Honig teaches that the one steering vector used for spatial processing for each subband is unknown to the receiving entity (see column 3, lines 43+, the receiver generates an “estimated” steering vector, as opposed to the given steering vector being the steering vector known to the receiver).

In view of the above, having the method of Trikkonen and Wallace, then given the well-established teaching of Honig, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen and Wallace as taught by

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Honig, since Honig stated in column 1, lines 66+ that faster tracking and convergence with less training samples can be achieved.

7. Claims 5, 16 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Trikkonen in view of Wallace as applied to claims 1, 15 and 20 above, and further in view of Kim et al. (previously cited US 6,937,189).

Regarding claim 5, Trikkonen and Wallace do not explicitly teach that the pilot and data symbols for each subband is spatially processed with at least two steering vectors selected for the subband.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Kim. In particular, Kim teaches that the pilot and data symbols for each subband is spatially processed with at least two steering vectors selected for the subband (see column 2, lines 34+, beamforming algorithm is chosen based on whether the data is a pilot data symbol or a non pilot data symbol, thus a different steering vector is obtained on a pilot data symbol than a data symbol).

In view of the above, having the method of Trikkonen and Wallace, then given the well-established teaching of Kim, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen and Wallace as taught by Kim, since Kim stated that the speed of optimal value convergence is increased.

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Regarding claim 16, Trikkonen and Wallace do not explicitly teach that the spatial processor is operative to spatially process the pilot and data symbols for each subband with at least two steering vectors selected for the subband.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Kim. In particular, Kim teaches that the pilot and data symbols for each subband is spatially processed with at least two steering vectors selected for the subband (see column 2, lines 34+, beamforming algorithm is chosen based on whether the data is a pilot data symbol or a non pilot data symbol, thus a different steering vector is obtained on a pilot data symbol than a data symbol).

In view of the above, having the method of Trikkonen and Wallace, then given the well-established teaching of Kim, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen and Wallace as taught by Kim, since Kim stated the speed of optimal value convergence is increased.

Regarding claim 21, Trikkonen and Wallace do not explicitly teach that the pilot and data symbols for each subband is spatially processed with at least two steering vectors selected for the subband.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Kim. In particular, Kim teaches that the pilot and data symbols for each subband is spatially processed with at least two steering vectors selected for the subband (see column 2, lines 34+, beamforming algorithm is chosen based on whether the data is a pilot data symbol or a non pilot

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data symbol, thus a different steering vector is obtained on a pilot data symbol than a data symbol).

In view of the above, having the method of Trikkonen and Wallace, then given the well-established teaching of Kim, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen and Wallace as taught by Kim, since Kim stated the speed of optimal value convergence is increased.

8. Claims 6, 10 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Trikkonen in view of Wallace as applied to claim 1, and further in view of Walton et al. (previously cited US 2003/0235147, published 25 December 2003).

Regarding claim 6, Trikkonen and Wallace do not explicitly teach that one pilot or data symbol is sent on each subband in each symbol period, and wherein the pilot and data symbols for each subband is spatially processed with a different steering vector for each symbol period.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Walton. In particular, Walton teaches that one pilot or data symbol is sent on each subband in each symbol period (see paragraph 110, each multiplier multiplies each symbol in its vector with its Walsh function to transmit two symbols per two consecutive symbol periods, thus averaging to one symbol per symbol period) and wherein the pilot and data symbols for each subband is spatially processed with a different steering vector for each symbol period (see paragraph 95, for each vector, the symbols are transmitted in different symbol periods on different antennas).

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In view of the above, having the method of Trikkonen and Wallace, then given the well-established teaching of Walton, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Trikkonen and Wallace as taught by Walton, since Walton stated that transmission diversity can be achieved with criteria such as channel conditions and receiver capabilities.

Regarding claim 10, Trikkonen and Wallace do not explicitly teach selecting the at least one steering vector for each subband from among a set of L steering vectors, where L is an integer greater than one.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Walton. In particular, Walton teaches selecting the at least one steering vector for each subband from among a set of L steering vectors, where L is an integer greater than one (see paragraph 95, two vectors are generated).

In view of the above, having the method of Trikkonen and Wallace, then given the well-established teaching of Walton, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Trikkonen and Wallace as taught by Walton, since Walton stated that transmission diversity can be achieved with criteria such as channel conditions and receiver capabilities.

Regarding claim 12, Trikkonen and Wallace do not explicitly teach selecting a steering vector for each subband in each symbol period from among a set of L steering vectors, where L is an integer greater than one.

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However, the above-mentioned claimed limitation is well known in the art, as evidenced by Walton. In particular, Walton teaches selecting a steering vector for each subband in each symbol period from among a set of L steering vectors, where L is an integer greater than one (see paragraphs 95 and 110, multiple steering vectors, where each steering vector belongs to a subband and a symbol period).

In view of the above, having the method of Trikkonen and Wallace, then given the well-established teaching of Walton, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Trikkonen and Wallace as taught by Walton, since Walton stated that transmission diversity can be achieved with criteria such as channel conditions and receiver capabilities.

9. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Trikkonen in view of Wallace as applied to claim 1 above, and further in view of Ketchum (previously cited US 2003/0108117).

Regarding claim 7, Trikkonen and Wallace does not explicitly teach that the at least one steering vector used for spatial processing for each subband is known only to the transmitting entity and the receiving entity.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Ketchum. In particular, Ketchum teaches that the at least one steering vector used for spatial processing for each subband is known only to the transmitting entity and the receiving entity (see paragraph 12, the steering vector known to the transmitting station is sent to the receiving

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station, therefore the transmitting station and the receiving station both know the steering vectors).

In view of the above, having the method of Trikkonen and Wallace, then given the well-established teaching of Ketchum, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen and Wallace as taught by Ketchum, since Ketchum stated in paragraph 10 that high throughput can be achieved without individually coding each frequency bin.

10. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Trikkonen in view of Wallace as applied to claim 1, and further in view of Jasper et al. (previously cited US 6,441,786).

Regarding claim 8, Trikkonen and Wallace do not explicitly teach that the spatial processing with the at least one steering vector for each subband is performed only on data symbols.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Jasper. In particular, Jasper teaches that the spatial processing with the at least one steering vector for each subband is performed only on data symbols (see column 9, lines 65+, steering vector is calculated for each data symbol).

In view of the above, having the method of Trikkonen and Wallace, then given the well-established teaching of Jasper, it would have been obvious to a person having ordinary skill in

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the art at the time of the invention to modify the method of Trikkonen and Wallace as taught by Jasper, since Jasper stated that the effects of interference and noise can be limited.

11. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Trikkonen in view of Wallace as applied to claim 1, and further in view of Shattil (previously cited US 2004/0086027).

Regarding claim 9, Trikkonen and Wallace do not explicitly teach encoding the PDU in accordance with a coding scheme to obtain coded data, interleaving the coded data to obtain interleaved data, and symbol mapping the interleaved data in accordance with a modulation scheme to obtain the block of data symbols.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Shattil. In particular, Shattil teaches encoding the PDU in accordance with a coding scheme to obtain coded data, interleaving the coded data to obtain interleaved data, and symbol mapping the interleaved data in accordance with a modulation scheme to obtain the block of data symbols (see paragraph 88, data is encoded, then the coded data is interleaved by an interleaver, then the interleaved data is mapped into data symbols in a block).

In view of the above, having the method of Trikkonen and Wallace, then given the well-established teaching of Shattil, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen and Wallace as taught by Shattil, since Shattil stated in paragraph 32 that greater bandwidth efficiency can be achieved.

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12. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Trikkonen in view of Wallace and Walton as applied to claim 10, and further in view of Hudson et al. (previously cited US 6,477,161).

Regarding claim 11, Wallace, Trikkonen and Walton do not explicitly teach that the L steering vectors are such that any pair of steering vectors among the L steering vectors has low correlation.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Hudson. In particular, Hudson teaches that the L steering vectors are such that any pair of steering vectors among the L steering vectors have low correlation (see column 6, lines 3-12, correlation between vectors is either nonexistent (orthogonal) or very small).

In view of the above, having the method of Wallace, Trikkonen and Walton, then given the well-established teaching of Hudson, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Wallace, Trikkonen and Walton as taught by Hudson, since Hudson stated that symbol detection can be improved.

13. Claims 13, 18, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Trikkonen in view of Wallace as applied to claims 1, 14 and 19, and further in view of Lewis (previously cited US 2004/0102157).

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Regarding claim 13, Trikkonen and Wallace do not explicitly teach that each steering vector includes T elements having same magnitude but different phases, where T is the number of transmit antennas at the transmitting entity and is an integer greater than one.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Lewis. In particular, Lewis teaches that each steering vector includes T elements having same magnitude but different phases, where T is the number of transmit antennas at the transmitting entity and is an integer greater than one (see paragraph 4, lines 11+, plurality of antennas are weighted and given phase differences for each steering vector).

In view of the above, having the method of Trikkonen and Wallace, then given the well-established teaching of Lewis, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the method of Trikkonen and Wallace as taught by Lewis, since Lewis stated in paragraph 6 that location based services can be provided.

Regarding claim 18, Trikkonen and Wallace do not explicitly teach that each steering vector includes T elements having same magnitude but different phases, where T is the number of antennas used to transmit the PDU and is an integer greater than one.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Lewis. In particular, Lewis teaches that each steering vector includes T elements having same magnitude but different phases, where T is the number of antennas used to transmit the PDU and is an integer greater than one (see paragraph 4, lines 11+, plurality of antennas are weighted and given phase differences for each steering vector).

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In view of the above, having the apparatus of Trikkonen and Wallace, then given the well-established teaching of Lewis, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the apparatus of Trikkonen and Wallace as taught by Lewis, since Lewis stated in paragraph 6 that location based services can be provided.

Regarding claim 23, Trikkonen and Wallace do not explicitly teach that each steering vector includes T elements having same magnitude but different phases, where T is the number of antennas used to transmit the PDU and is an integer greater than one.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Lewis. In particular, Lewis teaches that each steering vector includes T elements having same magnitude but different phases, where T is the number of antennas used to transmit the PDU and is an integer greater than one (see paragraph 4, lines 11+, plurality of antennas are weighted and given phase differences for each steering vector).

In view of the above, having the apparatus of Trikkonen and Wallace, then given the well-established teaching of Lewis, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the apparatus of Trikkonen and Wallace as taught by Lewis, since Lewis stated in paragraph 6 that location based services can be provided.

14. Claims 17 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Trikkonen in view of Wallace and Kim as applied to claims 16 and 21 above, and further in view of Ketchum (previously cited US 2003/0108117).

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Regarding claim 17, Wallace, Trikkonen and Kim do not explicitly teach that the at least two steering vectors for each subband are known only to a transmitting entity and a receiving entity for the data packet.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Ketchum. In particular, Ketchum teaches that the at least two steering vectors for each subband are known only to a transmitting entity and a receiving entity for the data packet (see paragraph 12, the steering vector known to the transmitting station is sent to the receiving station, therefore the transmitting station and the receiving station both know the steering vectors).

In view of the above, having the apparatus of Wallace, Trikkonen and Kim, then given the well-established teaching of Ketchum, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the apparatus of Wallace, Trikkonen and Kim as taught by Ketchum, since Ketchum stated in paragraph 10 that high throughput can be achieved without individually coding each frequency bin.

Regarding claim 22, Wallace, Trikkonen and Kim does not explicitly teach that the at least two steering vectors for each subband are known only to a transmitting entity and a receiving entity for the data packet.

However, the above-mentioned claimed limitation is well known in the art, as evidenced by Ketchum. In particular, Ketchum teaches that the at least two steering vectors for each subband are known only to a transmitting entity and a receiving entity for the data packet (see paragraph 12, the steering vector known to the transmitting station is sent to the receiving

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station, therefore the transmitting station and the receiving station both know the steering vectors).

In view of the above, having the apparatus of Wallace, Trikkonen and Kim, then given the well-established teaching of Ketchum, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the apparatus of Wallace, Trikkonen and Kim as taught by Ketchum, since Ketchum stated in paragraph 10 that high throughput can be achieved without individually coding each frequency bin.

Conclusion

15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Curtis A. Alia whose telephone number is (571) 270-3116. The examiner can normally be reached on Monday through Friday, 9am-6pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Aung S. Moe can be reached on (571) 272-7314. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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